

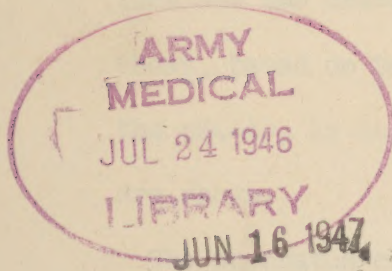
X-2

INDEXED

JAPANESE MEDICAL MATERIAL

X-RAY APPARATUS, PORTABLE, TYPE 2

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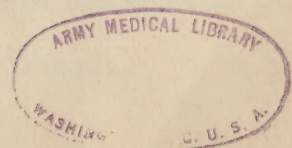


REPORT NO. 215

17 April 1946.

MEDICAL ANALYSIS SECTION
5250th Technical Intelligence Company
APO 500

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17 April 1946.

X-Ray Apparatus, Portable, Type 2

SOURCE: Kusatsu, Kyoto Prefecture, Japan.

IMPORTANCE: Not previously reported. Supplement to Medical Technical Reports No. 80 and No. 204.

DESCRIPTION: This portable apparatus consists of X-ray generator, necessary transformers and control devices, fluoroscopic screen, dark box and two 35 mm cameras for photographing screen, seat for use of patient when making chest x-rays, cooling fan for generator, plate holder for direct x-ray photographs, spare x-ray tubes, dark-room, and dark-room accessories. When packed for shipment, the complete set is carried in 11 sturdy wooden chests of varying dimensions and two crates for x-ray tubes. A list of contents of each chest, based on translation of the tables of contents supplied with the chests, is included in this report. Dimensions of each chest are shown.

The apparatus operates on single phase alternating current of either 50 or 60 cycles and is calibrated for use of each. A maximum of 5000 volt-amperes is required at a voltage of 100-200v. The x-ray circuit produces 95000 volts at 3 milliamperes continuous operation, or will produce 100 milliamperes at 70000 volts for one-second operation.

All high-voltage wiring is encased in grounded flexible tubing and stray x-rays are limited by the use of special changeable apertures producing fields of 60 cm, 80 cm and 100 cm.

A complete literal translation of the descriptive information accompanying the apparatus is included with this report.

COMMENT: This x-ray was used by the Japanese Army in all fixed and semi-fixed hospitals in communication and interior zones. The corresponding field equipment is described in Medical Technical Report No. 204. The apparatus may be used to make direct x-ray photographs either horizontal or vertical, but its principal use was the routine chest examination of Japanese soldiers and conscripts.

In this work two or four fluoroscopic views of each man's chest were photographed one or more times per year on 35 mm film, and these films examined, without in most cases, taking full sized plates for positive diagnosis of tuberculosis. To this practice the Army and the Navy (which used an almost identical apparatus) attribute most of the reduction in their tuberculosis rates. This procedure is not used in the US Army but mass surveys of American civilian groups have been so conducted in order to economize on the use of x-ray film.

It is believed that the apparatus is inferior in quality to corresponding US Army portable apparatus, but an exact comparison cannot be made by this section. The apparatus will be forwarded to the US for further study.

Photographs: Fig. 1 - Apparatus as packed and shipped.
Fig. 2 - Apparatus assembled.
Fig. 3 - Typical chest, containing dark-room accessories.



Fig. 1 - Apparatus as packed and shipped

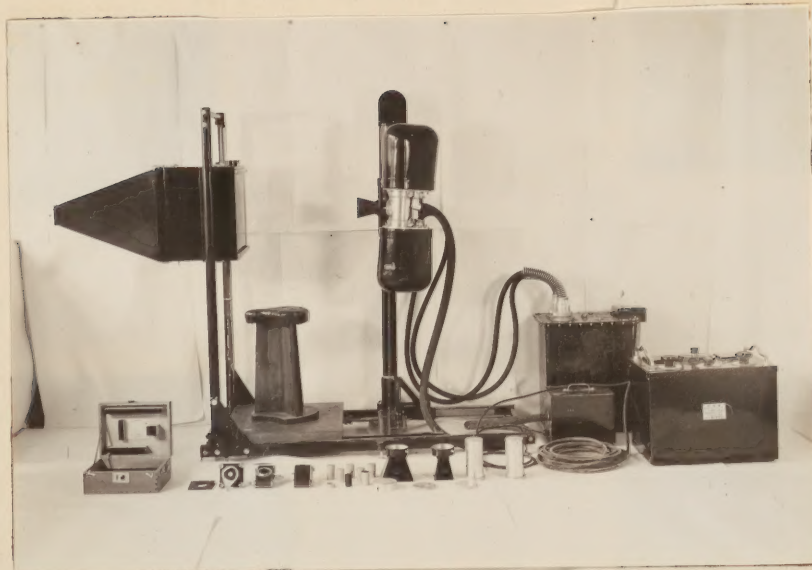


Fig. 2 - Apparatus assembled.



Fig. 3 - Typical chest, containing
dark-room accessories.

LIST OF CONTENTS OF EACH CHEST

CHEST NO. 1
(22 1/2" x 18 1/2" x 29")

- | | | |
|------------------------------|----|---|
| 1. Transformer, high voltage | ea | 1 |
|------------------------------|----|---|

CHEST NO. 2
(23 1/2" x 17" x 22")

- | | | |
|---------------|----|---|
| 1. Controller | ea | 1 |
|---------------|----|---|

CHEST NO. 3
(38 1/2" x 25 1/2" x 16")

- | | | |
|-----------------------------|----|---|
| 1. X-ray generator | ea | 1 |
| 2. High voltage connections | ea | 1 |
| 3. Fan unit | ea | 1 |

CHEST NO. 4
(29" x 21 1/2" x 21")

- | | | |
|------------------------------|----|---|
| 1. Dark box including camera | ea | 1 |
|------------------------------|----|---|

CHEST NO. 5
(58" x 29 1/2" x 14")

- | | | |
|----------------------|-----|---|
| 1. Base of apparatus | set | 1 |
|----------------------|-----|---|

CHEST NO. 6
(60 1/2" x 10 1/2" x 12")

- | | | |
|--|-----|---|
| 1. Stand for supporting x-ray generating apparatus | set | 1 |
|--|-----|---|

CHEST NO. 7
(58 1/2" x 32" x 14")

- | | | |
|--|-----|---|
| 1. Stand for supporting dark box and fluoroscope | set | 1 |
|--|-----|---|

CHEST NO. 8
(33" x 14 1/2" x 16 1/2")

1. Balance, laboratory	ea	1
2. Tank, developing	ea	4
3. Dark slides	ea	2
4. Lead plate	ea	1
5. Spectacles	pr	1
6. Apron	ea	1
7. Brushes, electric	set	1
8. Tape, cotton, sticking	roll	1
9. Water thermometer	ea	3
10. Spoon	ea	2
11. Tools	set	1
12. Fuse, thin	ea	1
13. Tape, measuring	ea	1
14. Electric cells	ea	4
15. Flashlight	ea	1
16. Explanatory books	ea	2
17. Graduates	ea	2
18. Funnel	ea	1
19. Cloth, black	sheet	1
20. Film markers	set	1
21. Film holder	ea	10

CHEST NO. 9
(33" x 14" x 16 1/2")

1. Chemical bottles	ea	5
2. Electric cord, for electric lamp	ea	1
3. Lamp for dark room	ea	1
4. Photograph examining table	ea	1
5. Enlarging glass	ea	1
6. Cooling tank	ea	8
7. Developing tank	ea	8

CHEST NO. 10
(33" x 14 1/2" x 17")

1. Metol	gm	25
2. Hydroquinone	gm	500
3. Sodium sulphite, dehydrated	gm	1000
4. Sodium carbonate, dehydrated	gm	500
5. Potassium bromide	gm	250
6. Sodium thiosulphate	gm	5000
7. Acetic acid, glacial	gm	500
8. Powder, alum	gm	200

CHEST NO. 11
(16" x 20" x 25")

1. Film, quarter size	ea	72
2. Film, for indirect radiography	roll	30
3. Film receiving box	ea	1

2 WOODEN CRATES
(12 3/4" x 12 3/4" x 40")

1. X-ray tubes

MISSING:

1. Bag containing dark-room, portable (tent)
2. Bag containing poles for tent

The Assembled Apparatus

Diagram 1

A. High Voltage Apparatus.

- (1) High Voltage Transformer
- (2) Controller
- (3) X-rays tube cooling wind-blower
- (4) Low Voltage cord attaching to source of electricity
- (5) Low Voltage cord for transformer
- (6) Ground wire
- (7) Ground pole
- (8) Wire for wind-blower

B. X-Rays Tube Apparatus.

- (9) Container for X-ray tube
- (10) High Voltage cord
- (11) Ray shutter

C. Fluorescent Photograph Stand.

- (12) Supporting base
- (13) X-Ray tube support
- (14) Dark-box support
- (15) Side dark-box for fluorescent plate
- (16) Side dark-box for camera
- (17) Camera
- (18) Examinee footstool
- (19) Examinee seat

D. Other.

- (20) X-Ray shuttering lid
- (21) Cable head protecting cap plug
- (22) Cap for high voltage of transformer

Diagram 2

Connection By Cords

- (1) Low voltage plug of transformer
- (2) Socket for transformer
- (3) Socket for wire blower
- (4) Socket for electric source (for 100 volts)
- (5) Socket for electric source (for 200 volts)
- (6) High voltage plug of transformer
- (7) Ground connecting plug

Diagram 3

- (1) Water-level
- (2) Sleeve of base
- (3) Projection of support
- (4) Fixing handle
- (5) Horizontal adjustment
- (6) Place wherein support is fixed
- (7) Vertical adjustment
- (8) Clasp
- (9) Dark-box attachment
- (10) Wire
- (11) Upper pulley
- (12) Dark-box support
- (13) Rod
- (14) Shaft ring
- (15) Connecting ring
- (16) Horizontal movement braking handle
- (17) Graduation for horizontal movement
- (18) Vertical Mark
- (19) Level adjusting screw

Diagram 4

The Disassembled X-Ray Tube Container

- (1) X-Ray tube
- (2) Radiator
- (3) Protecting cover
- (4) Insulated cylinder
- (5) Wire of high voltage cord
- (6) Ray shutter
- (7) Washer and screw
- (8) Fixable part
- (9) Aperture
- (10) X-Ray tube holder
- (11) Screw
- (12) Negative pole heating wire

Diagram 5

The Fixed Tube Container

- (1) Socket for tube-container holder
- (2) Clasp
- (3) Handle

Diagram 6

The Fixed Dark-box

- (1) Dark-box attachment
- (2) Clasp
- (3) Examinee's chin support
- (4) Film dark slide support

Diagram 7

- (1) Socket for leading electricity to dark room lamp
- (2) Ventilating pipe
- (3) Tent
- (4) Window
- (5) Red colored filter board
- (6) Curtain

Diagram 8

- (1) Ammeter, double purpose
- (2) Filamentary voltage reading switch
- (3) Overload circuit breaker
- (4) Time limiting switch
- (5) Primary voltage reading push-button
- (6) Voltmeter, double purpose
- (7) Table of voltage
- (8) Voltage regulator, double purpose
- (9) X-Ray switch
- (10) Ampere regulator, double purpose
- (11) Table of filamentary amperage

Diagram 9

- (1) Film dark slide support

Diagram 10

- (1) Back lid opener
- (2) Back lid

- (3) Film turning spool
- (4) Magazine
- (5) Film turning handle
- (6) Film carrying gear
- (7) Film turning release
- (8) Slide-lid

Diagram 11

Camera

- (1) Back lid opener
- (2) Back lid
- (3) Film turning spool
- (4) Film turning handle
- (5) Slide-lid
- (6) Photograph number graduated
- (7) Lens support
- (8) Lens support screw
- (9) Camera fastening plate
- (10) Photograph number graduated

Diagram 12

Lens Part of Camera

- (1) Camera fastening plate
- (2) Lens cover
- (3) Lens cover
- (4) Lens base
- (5) Plate

Diagram 13

The Disassembled Cartridge

- (1) Film spool
- (2) Magazine external tube
- (3) Magazine internal tube
- (4) Spring
- (5) Projection

Diagram 14

Assembled Film Cartridge

Diagram 15

Developing Tank

- (1) Body
- (2) Lid
- (3) Inside frame
- (4) Stirring stick
- (5) Pouring mouth

Diagram 16

Inside Frame of Developing Tank

Diagram 17

Preparation For Developing In The Dark Room

How To Roll Film

Diagram 18

Preparation For Developing In The Dark Room

Fix The End Of Film With A Clasp

Diagram 19

Putting It Into The Tank

Diagram 20

Putting The Lid On

Diagram 21

Stirring The Solution

TRANSLATION

EXPLANATORY NOTES

for

X-RAY APPARATUS, PORTABLE, TYPE 2

By

The Shimazu Manufacturing Co. Ltd.

No. 18 Kuwaharamachi, Nishinokyo,

Nakakyoku, Kyoto

Outline Of This Machine

Purpose:

This machine is used for taking direct x-ray photographs and the fluoroscopic examination, and this machine is purposely used for the physical examination of conscripts and the others in mass examinations.

Composition

This machine consists of four parts as seen in the 1st diagram..

1. High voltage apparatus.
2. X-Ray tube apparatus.
3. Fluorescent photograph stand.
4. Accessories.

These parts are kept in 12 medical panniers, 2 bags (portable dark-room) and 2 wooden boxes for keeping the x-ray tubes. Anytime and anyplace this machine can be assembled or disassembled and transported conveniently.

Classification According To The Electric Machine Regulation

In this machine, all the outside of the high voltage parts are covered with the metal to be grounded. No exposed part can be found. This machine is exactly the same as the Type 1 x-ray machine which was regulated by Article 131 of Electric Machine Regulation.

The Method Of Connecting The Circuit Of X-Ray Tubes

The method of connecting the circuit of x-ray tubes. This is the self-commutating method in which the end of the high voltage is directly connected to the x-ray tube.

The Method Of Protecting Men Against X-Rays

The tube-container of this machine is provided with the x-ray shutter fit for No. 32 of Home Office Order which regulates that stray x-rays must not be more intense than those which pass through the 1.2mm of lead.

Capacity

Power of the circuit of the x-ray tube:

Voltage in x-ray tube	95 kilovolts	70 kilovolts
Amperage in x-ray tube	3 milliampere	100 milliampere
Capacity	1 second	

Source of electricity:

Type	Single-phase alternating current
Frequency	50-60 cycles
Voltage	100-200 volts
Capacity	5 kilovoltampere

An insulated electric wire whose diameter is more than 4mm and whose length is less than 50 meters is necessary.

Method Of Assembling (See The First Diagram For Reference)

High voltage apparatus (see the 1,2,22 and 23 diagram)

Take the apparatus out of the panniers (medical pannier No 1-3) anywhere, and put high voltage transformer, controller and x-ray tube cooling wind-blower on a suitable place.

1. Connect one end of ground wire (6) to a ground relating side of the high voltage transformer, and connect the other end to any hydrant or a ground pole (7) stuck in the ground.

2. Insert high voltage electric cards in sockets (f) of the high voltage transformer and tighten.

3. Connection of low voltage cord. Connect low voltage cord for transformer (5) to the low voltage side (a) according to each mark as seen in the 2nd diagram (an already composed transformer may be seen in many cases.) Next connect the other end to plug of controllers.

4. Connect the end of electric wire for wind-blower (8) to socket for wind-blower (c).

5. Connect low voltage cord for electric current to either socket (d) or (e) in accordance with voltage of electric source available (100 or 200 volts), then connect the other end to the source. Note-- Only after finishing the whole assembly should low voltage cord for electricity be connected to the electric source.

Fluorescent Photograph Stand (See Diagrams 1,3,4,5.)

1. Settle base (12) on any suitable place. In this case it is necessary to make it level by a water-level (a) and a level adjusting screw (s).

2. Set projection of support (c) in sleeves of base (b), then fix dark-box support, and screw up screw (d).

3. Insert x-ray tube support (13 in the 1st diagram) in the place wherein it is fixed (f) of horizontal adjustment (e) of the base, fix them with handle (d), then fix vertical adjustment (g) at the lower part, and hang connecting wire on clasp (h) of the vertical mover (g).

4. With the dark-box attachment (i) held by one hand, connect rod (m) of the top of the wire (j), then let go and the wire will be adjusted. Note--The disassembly is in reverse order.

5. Set x-ray tube holder (j) of the 4th diagram in socket of the vertical adjustment on the support (a of the 5th diagram) as follows: Set the holder using clasp (b of the 5th diagram), adjust x-ray tube vertically according to the mark of the inserted part, then secure it with handle (c).

6. Put a footstool for examinee on the base, then set the seat on it. (See the 1st diagram for reference).

7. A dark-box consists of two parts---a side box for fluorescent plate (15) and a side dark-box for camera (1b). Both must be fastened to the dark-box fixing body (a) with clasp (b).

X-Ray Tube Apparatus (See The 4th Diagram)

1. Loosen screw (k) on both ends of the insulated cylinder (d) for the purpose of inserting x-ray tube, adjust the focus of the tube (a) to the direction of aperture (i), insert the tube carefully through the negative pole of the insulated cylinder (d)---the side to which 2 wires of the high voltage cord are pulled out---, then set a projection of the positive pole of the tube in the channel of the ring for fixing a positive pole of the insulated cylinder, and fasten both ends with push-screw (k). Note--The screw must be carefully tightened.

2. Set radiator (b) on the positive pole of x-ray tube, screw up the positive side of wire of high voltage cord (e) in the plug of the radiator, then connect negative pole heating wire (e) to the negative socket of x-ray tube.

3. Adjust protecting cover (c) to the part (h) and fix it with washer and screw (g).

4. Fix ray shutter (f) to an aperture suitable to the distance between the focus of x-ray tube and the fluorescent plate must be used. This machine is provided with 3 kinds of shutters-60, 80, and 100 cm. An x-ray shuttering cap (21 of 1st diagram) is used for the purpose of shuttering the x-ray during the prearrangement of photographic conditions when the current is turned on.

5. Insert one end of cooling wind-pipe to the socket of the wind blower.

Portable Dark-Room (See The 7th Diagram for reference)

The portable dark-room (see Diagram 7) consists of poles, tent, ventilating pipe, red colored filter-board etc. In composing this room, great care must be taken to avoid direct sunshine at its entrance and window.

1. Compose poles according to the marks.

2. Set tent on them.

3. Set both ends of ventilating pipe to the upper and lower parts to which it is set from the inside, and tie them with a string to prevent light from entering.

4. Fix red colored filter-board to the window. It has two kinds of red colored filter boards--namely a deep colored and a light colored. Either one should be used according to the conditions of development. The light can be adjusted by closing or opening the curtain.

5. Make the upper part of curtain level so as not to have the light come from the outside. If necessary, it can be weighted with sand or any other suitable material.

How To Use

(1) How to operate the high voltage apparatus (See Diagram 1 and 8)

1. How to take indirect photographs.

(1) All the leading wires must be completely connected to each part. First, be sure the switch and controlling board is turned to "open", and that each regulator is on the lowest position.

(2) Close switch. The x-ray tube cooling wind-blower begins to move.

(3) When electric sources voltage reading push button (e) is pushed down, voltmeter (f) indicates the voltage. Note--In case voltage is 100 volts, it goes without saying that the needle of the meter indicates 100 volts, nevertheless, in case of 200 volts, it also indicates 100 volts for the reason of this meter was made to indicate $\frac{1}{2}$ value of voltage of the electric resource instead of indicating 200 volts for lack of graduation space. So we hope no mistake will be made in handling it.

(4) Turn filamentary voltage reading switch (b) to "heat"; Turn x-ray switch (2) to the left side "heat", then look for the voltage (about 67 volts) suitable to the required filamentary current (when 30 milliampere in x-ray tube is wanted, about 4.1 amperes) and regulate regulator (j) to make volt value indicated on voltmeter (f). Note--The table of filamentary amperage (k) was made by marking actual filamentary amperage in x-ray tube on the perpendicular columns, and a primary voltage of the transformer regulated by a regulator (indication of voltmeter (f) the horizontal column).

(5) Turn filamentary voltage reading switch (b) to "secondary". From table of voltage (g), the primitive voltage equivalent to 80 volts "wave height value" can be obtained. Regulate this voltage to be the same as an indication of voltmeter (f) with regulator (j). Note---The table of voltage was made by marking a filamentary voltage of transformer on the perpendicular column, and a primary voltage regulated by a regulator on the horizontal columns.

(6) Turn time limiting switch (d) to the required time for photographing (about 1.0 second).

(7) On seeing photographer's sign, turn x-ray switch (1) to "photograph" and radiation begins. The ammeter (a) indicates the amperage in x-ray tube. (about 30 milliampere).

(8) In case of photographing continually, replace x-ray switch to "open" by turning it to the right and many photographs will be continually taken under the same condition by repeating the operation of (7). Note--As voltage, ampere and time are interrelated, great care must be

taken in regulating the filamentary amperage, (iii) In photographing, the x-ray switch must not be left at the point of "heat" for a long period of time.

How To Take Direct Photographs

This method is almost the same as that of the above mentioned indirect photographs, but in this method, x-ray films are used in place of camera. In taking the photographs for chest examinations, voltage in x-ray tube must be about 50 kilovolts "wave height value", while the amperage in the tube must be made as large as possible (maximum in this machine) (100 milliamperes), the time must be as short as possible and the distance must be as far as it is possible. Concerning the conditions of directly photographing chapter (iii) should be read.

How To Operate With Fluoroscope

This method also is almost the same as that of photographing and its order is as follows:

1. Same as clause (1) of "the method of taking indirect photographs.
2. Same as clause (2) of "the method of taking indirect photographs.
3. Same as clause (3) of "the method of taking indirect photographs.
4. Turn filamentary voltage reading switch (b) to "heat". Turn x-ray switch (i) to "heat" at the right side, then check voltage (about 55 volts) to know the required filamentary amperage about 3.5 ampere in case of adjusting to 3 milliamperes. Then regulate ampere regulator (j) to make the voltage the same as indication of 3 voltmeter (f). Note--With the fluoroscope about 3.5 amperes is preferable.

5. Turn filamentary voltage reading switch (b) to "secondary", then regulate the fluorescent voltage after learning it from a table of voltage (g).

6. When x-ray switch (i) is turned to "fluorescence" on the right, x-rays generate, and amperemeter (a) indicates the fluorescent amperage. Note--The fluoroscopic use is different from a radiography, for small quantity of current is sufficient for the amperage of the x-ray tube (3 - 5 milliamperes). Nevertheless, as the time is comparatively long, it is convenient to do as follows in order to regulate filamentary amperage and the voltage of the x-ray tube. First turn on high voltage at the lowest position, then regulate it at the direction of the operator.

Precautions

1. When first testing after the assembly, be sure the switch indicates "open" and each regulator is at the lowest position.
2. After usage, each regulator must be replaced to the lowest position and the movement of a wind-blower for cooling a tube must be

continued for its purpose for awhile, but primary electric switch should be kept closed.

3. Examine the sockets in which wires are inserted.

4. The red lined graduation of voltmeter shows the point of the filamentary voltage "80 kilovolts" wave height value, which is a standard point of voltage for 30 milli amperes.

5. In case of using the primary voltage up to the capacity of the electric sources, use no more than 120 volts.

6. An over-load automatic shutter automatically breaks the circuit as soon as any phenomenon of overload appears during the fluorescent period. To replace it to the former state--closed--, push down the shutter (a). So in case the x-rays do not generate in spite of the x-ray switch is necessary to push down this (c).

7. When cooling wind-blower is used for a long time, the carbon brushes of the motor become defaced, so in such a case replace with a spare brush.

How To Operate The Fluorescent Photographing Stand

1. How to take the indirect photograph. Fixation of a camera (see diagram 6,10,11,12 for reference). First fix a projection of lens supporter (h) to a dark-box, fasten it by screwing a lens supporter fixing screw (i), then fix the camera to the lens supporter (h), turn the camera fixing metal to the left to secure the camera. Lens covers (j & k of diagram 12) must be taken off, and slide (h) must be pulled out.

2. Adjust x-ray tube to a photographing distance required, then fix an aperture (11 of 1st diagram) to the x-ray cone.

3. Make examinee sit on a stool, then adjust dark-box to the suitable position by moving it up or down, and get the examinee to sit close to the dark box.

4. In taking photographs, make the examinee sit perfectly still; then let the operator give a signal.

5. After taking a photograph, turn the film to the next one.

6. When the camera is not in use (as in fluorescence), push a slide in, and keep the camera in place, so as not to be exposed to x-rays.

How To Take Direct Photographs (See Diagram 9 For Reference)

1. Fix a film dark slide support at the lowest part of each of the fluorescent plate as seen in the 9th diagram, settle film dark slide on it, then take a photograph after making an examinee set close by, as in taking indirect photographs; the camera must be taken out of the dark box before the operation.

How To Operate With Fluoroscope

1. Leave only the dark-box of fluorescent plate, take off a slide dark box of fluorescent plate, then cover the fluoroscope with a black cloth kept in the 8th medical pannier. Now the fluoroscope can be used. Fluoroscopic operation should be begun when operator has become accustomed to light by using a pair of dark familiarizing spectacles (kept in the 8th medical pannier).

Conditions For Taking Photographs

Conditions for taking indirect photographs.

- | | |
|--|-----------------|
| 1. Voltage in x-ray tube | 80 kilovolts |
| 2. Amperage in x-ray tube | 30 milliamperes |
| 3. Time | 1.0 second |
| 4. Distance between the focus of x-ray tube and film | 80 centimeters |

Conditions for taking direct photographs.

- | | |
|---|-----------------|
| 1. Voltage in x-ray tube | 50 kilovolts |
| 2. Amperage in x-ray tube | 80 milliamperes |
| 3. Time | 0.3 second |
| 4. Distance between the focus of x ray tube and film face | 100 centimeters |

The above mentioned conditions are for masculine constitution, so they must be changed in accordance with the difference of physical constitution.

Camera

How to use camera (see diagram 10, 11, 12 for reference)

1. Open lid (b) after adjusting each lid opener to the red mark.
2. Pull film turning knob (c) out of its side, insert it by adjusting projection (e of 13th diagram) of the external tube of a cartridge (d) to the lower part, then fix it by pushing film turning knob (c). A cartridge can be inserted only when back lid opener (a) is at the red mark.
3. Pull out one edge of a film from the cartridge, insert it in a slot of a spool, then turn a film up rolling knob (d) to the right until holes of film sides will gear each other with film transporting gear (f).
4. Adjust the back lid opener (a) to the red point after closing the lid, turn a film turning handle (d) to the right until it will stop, then push film turning push-button (g), and again turn the film up-rolling metal.

5. Adjust by turning a photograph numbers graduator controlling projection (j), adjust 1 on a graduate plate to the direction of arrow which indicates the first part of film was done. After the second part of a film, the graduated plate also moves with a film turning handle, but when a title of a photograph is taken, it should be adjusted to 0.

6. When the camera is taken out of the machine lid (e) must be pushed in.

7. When all parts of a film are used up, slowly turn the film with knob (c) in the direction of arrow, pushing film turning push button (g) until turning stops, Then reroll the film in the cartridge, open the back lid, take out the cartridge, and develop the film.

8. Placing of film in the cartridge (see diagrams 13 & 14 for reference). Insert one end of a film in the slot of a spool, then roll it up on the spool (In this case, cut off both margins with scissors to a tapered point). Put the spool already rolled up in the internal tube of the cartridge. Pull one end of the film about 1cm from the curved part of the internal tube of the cartridge. Put the internal tube in the external tube, pull about 10 cm of the film out of the curved part, then turn slowly. Film will stop itself with a click.

When the internal tube is taken off, open the spring to the outside and turn to the right.

Developing

1. Preparation of developing solution and fixing solution. Make developing solution and fixing solution in accordance with the regular method, and reserve them in some brown glass bottles. The method of making developing solution and fixing solution is the so-called regular way, which is most suitable to film.

One example of this is as follows:

(1) How to make developing solution for indirect photography.

Water	500 cc
Methol	1 gram
Hydroquinine	9 grams
Sodium carbonate, dehydrated	25 grams
Potassium bromide	5 grams
Sodium sulphite, dehydrated	75 grams

Make the whole quantity to 1000 cc with cold water. Standard temperature in using the developing solution should be 18° C.

(2) How to make developing solution for direct photographs.

Water	500 cc
Methol	2.5 grams
Sodium sulphite, dehydrated	105.5 grams
Hydroquinine	10.0 grams
Sodium carbonate, dehydrated	52.50 grams
Potassium bromide	6.5 grams

Make the whole quantity to 1000 cc by adding cold water. Standard temperature in using a developing solution is 18° C.

(3) How to make fixing solution

The way of making fixing solution is the same for direct photographs and indirect photographs.

First solution

Water	1000 cc
Sodium hyposulphite	250 grams

Second solution

Glacial acetic acid	15 cc
Sodium sulphite, dehydrated	15 grams
Alum powder	15 grams

(4) How to make developing solution. The method of making developing solution is exactly the same in both direct and indirect photographs. The developing solution for film is much more concentrated than the one for the common dry plate, accordingly it is hard to dissolve. The water for dissolving methol and hydroquinine should be below 50° C, to avoid foggy pictures. The water above this temperature must not be used. The following procedure should be used:

- (a) Solve about $\frac{1}{4}$ the sodium sulphite in 50 cc of water.
- (b) Dissolve the methol in them.
- (c) Next dissolve hydroquinine, then mix, adding the rest of sodium sulphite little by little, because methol is liable to produce some precipitate in the concentrated solution of sodium sulphite.
- (d) Dissolve sodium carbonate in this solution, and then the potassium bromide. Then make the whole quantity to 1000 cc by adding 480 cc of cold water. For the purpose of preserving a developing solution for a long time. A second solution must be made as follows:

Water	500 cc
Sodium carbonate, dehydrated	52.5 grams
Potassium bromide	6.5 grams

(5) How to make fixing solution. The degree of fixation has something to do with the preserving of film. Even if the wash is rather imperfect, no harm will be done if only the fixation is perfectly done.

- (a) Make the first solution.
- (b) Dilute some glacial acetic acid with water, add anhydrous sodium sulphite, then make up to the transparent second solution by adding alum to them.

- (c) Stir the first solution, adding the second solution little by little.

Note--the second solution must be colorless and transparent.

2. How to develop film of indirect photographs (see diagram 15-21)

Take used cartridge out of the camera according to ((7) how to operate camera), then develop it by putting it in a developing tank.

(1) Construction of tank.

The construction of the tank is shown in the 15th and the 16th diagrams. It consists of a body (a), a lid (b), an inside frame (c), a stirring stick (d) and a film protector (the 17th diagram).

The breadth of an inside frame is 35 mm and it has construction suitable to the film of indirect photography. One end of a stirring stick can be inserted for stirring film.

The 15th diagram (e) shows the mouth from where the solution is poured, and through which a stirring stick can be inserted. Beside the above, a water thermometer can be inserted for the purpose of measuring the temperature of the solution.

(2) The method of developing in the tank.

In this method, a film must be rolled around a frame pole and put in a tank only in the dark room, but development, washing and fixation can be done in a light place. The method is explained by diagrams 17-21.

Insert one end of celluloid film protector in a metal clip on the inside frame, wind it once or twice, extinguish the light, put film on the protector facing the surface of the film to inside, then wind up both loosely.

If they are too tightly wound up, the surfaces of film and protector will touch and film will not be developed. Next hold the film with right hand as seen in the 19th diagram, let the protector roll naturally, lightly hold the outside of a protector with the right hand. The teeth of the back of the lid will mesh with one of the frame and the tank becomes as seen in the 20th diagram. After this operation, development can be done in the light. At first pour the pure water through a pouring mouth, wash 1-2 minutes, then throw away the water. Pour in developing solution, and vibrate or shake the tank lightly to prevent any adherence of bubbles.

During the developing operation, revolve lightly then stirring stick inserted in the tank as seen in the 21st diagram. Continue to develop for about 5 minutes, examining the temperature with a water thermometer, then exhaust the developing solution out of the exhaust mouth into a bottle.

Then, pour water into the tank, and finally pour the fixative solution. Revolution of the stirring stick is necessary to this operation. After finishing the fixation, pour the fixing solution out of the tank and wash with water.

It is best to run water directly from a faucet into the hole of the rolling cylinder during washing. After washing take the film off the protector on the cylinder, and wipe off water drops on the film-face with some clean wet cotton.

The film protector must be dried before reuse. In case many rolls of film are simultaneously developed, use many tanks half of which contain developing solution and the other half of which contain fixing solution, then keep the temperature at 18°C with the cooling tub (kept in the 9th medical pannier), extinguish lamp to make the room dark and develop the film rolled up around the cylinder by putting them in the tank which contains the developing solution.

Extinguish the lamp again when the development is finished. Take the rolled film out of the tanks, then fix them in the fixing tanks after washing in another container. On finishing the fixation, take them out of the tanks and wash them with water in another container. The wash should be continued at least 30 minutes.

When the wash is completely finished, they must be completely dried as above mentioned.

NOTE: The diagrams referred to in this translation are not reproduced here. The original document, including diagrams, will be shipped to the Medical Department Equipment Laboratory along with the complete x-ray apparatus.